The Use of a Foot Orthotic in a Runner with Persistent Iliotibial Band Friction Syndrome

A Capstone Project for PTY 768
Presented to the Faculty of the Physical Therapy Department
Sage Graduate School

In Partial Fulfillment
of the Requirements for the Degree of
Doctor of Physical Therapy

Beth W. Swanson, PT, MS, OCS
May 2009

Approved:

____
Esther M. Haskvitz, PT, PhD, ATC
Research Adviser

____
Esther M. Haskvitz, PT, PhD, ATC
Program Director, Transitional Doctor of Physical Therapy Program

SAGE GRADUATE SCHOOL

I hereby give permission to Sage Graduate School to use my work,

The Use of a Foot Orthotic in a Runner with Persistent Iliotibial Band Friction Syndrome

for the following purposes:

- Place in the Sage Colleges Library collection and reproduce for Interlibrary Loan.
- Keep in the Program office or library for use by students, faculty, or staff.
- Show to other students, faculty or outside individuals, such as accreditors or licensing agencies, as an example of student work.

Beth W. Swanson, PT, MS, OCS Date

I represent to Sage Graduate School that this project and abstract are the original work of the author and do not infringe on the copyright or other rights of others.

The Use of a Foot Orthotic in a Runner with Persistent Iliotibial Band Friction Syndrome

---

Beth W. Swanson, PT, MS, OCS   Date

Acknowledgement

Thank you to my family, friends, and especially my business partner who have provided overwhelming support throughout this process.

The Use of a Foot Orthotic in a Runner with Persistent Iliotibial Band Friction Syndrome

Beth W. Swanson, PT, MS, OCS
May 2009

Abstract

Background and Purpose. Iliotibial band friction syndrome is common in distance runners and presents as lateral knee pain. Excessive mileage and anatomical faults are considered to be primary factors in its development. The purpose of this case report is to describe the physical therapist management of a female distance runner who had excessive mileage, but not any of the anatomical faults thought to contribute to this condition. **Case Description.** The patient was a 48 year old female distance runner who had been experiencing left lateral knee pain for 2 weeks prior to her initial physical therapy visit. Findings on examination were pelvic and sacral asymmetry, right hip weakness, and mild foot pronation. The patient was seen for 13 visits over a 10 week period. Interventions initially consisted of ultrasound, iontophoresis, and deep friction massage. Muscle energy techniques were used to balance her pelvis and sacrum, and she was instructed in non-weight bearing hip strengthening exercises. All identified impairments were corrected; however, she continued to report moderate pain after running 4 to 5 miles. At the 12th visit, a 3 degree medial rearfoot wedge was placed in each running shoe. **Outcomes.** Twelve days after posting her running shoes the patient reported complete resolution of her symptoms. **Discussion.** The impairments identified in the examination were resolved within the first 10 visits, but moderate discomfort persisted. An examination of her running as pain diminished may have indicated the need for an orthotic earlier in the intervention phase.

Key Words: iliotibial band, iliotibial band friction syndrome, lateral knee pain, orthotic

Introduction

Iliotibial band friction syndrome (ITBFS) is common in distance runners[1,2] and presents as lateral knee pain at the level of the femoral epicondyle. Repetitive flexion and extension of the knee causes excessive rubbing of the iliotibial band (ITB) over the lateral femoral epicondyle[1,3,4] resulting in pain and inflammation of the distal ITB.[1,3-10] There is some controversy as to whether a bursa is present between the distal ITB and the lateral femoral condyle, which may contribute to the lateral knee pain associated with this diagnosis. Renne[7] reported a bursa at the tip of the lateral epicondyle of the femur during a dissection and later aspirated fluid from this area in an individual known to have ITBFS. Orava[11] reported bursal tissue just distal to the lateral femoral epicondylar prominence during cadaveric studies and/or knee surgeries in 13 individuals. Noble[12] reported no evidence of true bursal tissue in this area in 8 surgical cases. Anatomy texts do not describe a bursa in this area.[13,14] Much of the literature indicates the lateral knee pain associated with ITBFS is from soft tissue injury to the distal ITB caused by excessive rubbing of the ITB over the lateral femoral epicondyle[7,9-11,15,16] creating a tendonitis in which the soft tissue damage from the repeated stress to this tissue occurs at a rate greater than which it can repair itself.[4,8,17]

The iliotibial band originates proximally via fascial bands of the tensor fascia lata, the gluteus medius and the gluteus maximus. This fascial band extends distally, attaching along the linea aspera of the femur, through the lateral intermuscular septum and attaches distally on the lateral tibial condyle and the patella.[4,18] The ITB is thought to function as an anterolateral stabilizer.[4] The pull of the proximal muscle attachments help maintain the ITB's posterior position to the hip joint axis to assist in keeping the hip in extension, and the distal attachment assists in keeping the knee in extension. This is important as minimal muscle activity is then required to maintain an upright posture.[18] The ITB is free from bony attachments between the superior aspect of the lateral femoral condyle and its distal insertion, which lends itself to the friction issues thought to be the cause of this disorder.[4] During gait, the ITB moves from an anterior position when the knee is extended to a posterior position when the knee is flexed, providing an opportunity for friction to occur between the distal ITB and the lateral femoral condyle. This transition zone, also described by some as the impingement zone, occurs at approximately 30 degrees of knee flexion.[1,3,4,6]

Several etiological factors have been described that may contribute to the development of ITBFS. Training errors are thought to be the most common cause of ITBFS, with excessive and/or sudden increase in mileage being the most prevalent.[1,3-7,10,16] Hill training is also recognized as a training practice that may increase the likelihood of ITBFS,[1,3,4] as is running on crowned or banked roads.[10,15] Training factors are the most widely agreed upon cause of ITBFS.[1-12,15,16]

Many anatomical factors have also been described that are thought to contribute to the development of ITBFS. Foot abnormalities,[10,15,16,19] Q-angle differences (both increased or decreased),[4,10,15,16] leg length discrepancies,[4,15,16,19] prominent lateral femoral condyle,[4,7,10,16] weakness of the lateral hip muscles,[3,5] and ITB tightness[1,4,10,16] are all cited in the literature as factors that may contribute to this condition. In his study of 41 distance runners with ITBFS compared with a non-injured control group, Schwellnus[19] reported significant differences between the groups in regards to leg length difference, Q-angle, and forefoot varus. Some authors who describe anatomical factors as predisposing one to ITBFS discuss them theoretically as causing an increase in the tension of the ITB, creating an increase in mechanical stress at the lateral femoral epicondyle, but did not support their theories by way of controlled studies.[4,10,16]

Several authors discuss the role of abnormal foot mechanics in the development of ITBFS. These authors suggest that excessive pronation causes increased tibial internal rotation which increases tension of the ITB producing an irritation at the lateral femoral condyle.[4,10,16] Cornwall and McPoil[20] found good correlation between rearfoot motion and tibial internal rotation, and the introduction of a foot orthotic decreased maximal tibial internal rotation in walking. Naworzinski et al[21] studied the effects of semi-rigid orthotics on lower limb kinematics in runners and found a mean reduction of 2 degrees in tibial internal rotation, with the most change occurring in the first 50% of the stance phase. In contrast to these findings, Reischl et al[22] found that the magnitude and timing of peak pronation was not predictive of the magnitude and timing of tibial or femoral rotation during gait. The use of foot orthotics to control pronation, which may decrease tibial internal rotation[20,21] and theoretically decrease the tension stress to the ITB, may be advantageous in the treatment of ITBFS.[20,21] In a study by Donatelli et al[23] patients with a wide variety of lower extremity complaints reported pain relief with the use of a foot orthotic. No controlled studies were found that show that a foot orthotic to control pronation has a direct effect on the resolution of ITBFS.

Interventions for ITBFS are not well described in the literature and primarily address the inflammation stage. Medically, interventions at this stage consist of over the counter or prescribed anti-inflammatory drugs, cortisone injection, and rest.[3-7] Other interventions at this stage include activity modification, modalities to control inflammation, and attempts to correct the biomechanical faults identified.[3-6,8-12,16,24] In a systematic review of the literature on the conservative treatment of ITBFS, Ellis et al[6] found little evidence to support conservative management of this disorder, with the interventions including non-steroidal anti-inflammatory drugs, deep friction massage, phonophoresis, immobilization, and cortisone injection.

Most of the anatomical faults described are believed to increase the tension of the ITB, so much of the literature addressing interventions for ITBFS describe lateral hip strengthening and ITB stretching.[3,5,18] Weak lateral hip muscles do not adequately fire during gait and provide less stability at the pelvis, causing femoral adduction, which places increased tension on the ITB.[3] A tight ITB will contribute to the mechanical stress of the distal segment during repetitive flexion and extension of the knee.[5] Exercises to address ITB tightness are well described in the literature.[5,18]

Although the literature does not support the theories that have been described as the causes of ITBFS, conservative interventions for this disorder have been successful. In a study by Renne[7] 16 cases of ITBFS were managed conservatively with rest and anti-inflammatory agents, and all returned to activity in 6 weeks. Noble[24] reported a 93% success rate (68 out of 73 patients) with conservative treatment (steroid injection and rest), and Orava[11] reported an 88% success rate (74 out of 84 patients) with treatment consisting of rest, anti-inflammatory agents, and steroid injections. Schwellnus et al[9] and Aronen et al[8] also reported successful treatment of ITBFS with conservative treatment.

The only consistent finding in runners with ITBFS is excessive mileage.[1,3-12,15,16,24] There are many theories that propose how different anatomical faults could predispose an individual to ITBFS, but few studies to support them. There were no studies found that indicate rest alone is sufficient to return a distance runner to his/her previous mileage level. An individual who presents with none of the proposed anatomical faults for ITBFS provides an opportunity to further evaluate possible causes of this disorder. The purpose of this case report is to describe the physical therapist management of a female runner who presented with persistent ITBFS who did not present with the anatomical faults thought to be associated with this condition.

Case Description

The patient was a 48 year old female who referred herself to physical therapy with complaints of left lateral knee pain of 2 weeks duration and insidious onset. The patient was a long distance runner, averaging 50-60 outside miles per week for more than 20 years. The patient reported an 8/10 on a 0-10 pain rating scale (where 10 is excruciating pain and 0 is no pain) after running for approximately 2 miles and 3/10 pain with stair climbing. The patient rated pain at 1/10 at rest. The patient denied any popping or snapping, edema, or ecchymosis. She indicated good habits in regards to purchasing new running shoes at regular intervals, generally every 6-8 months. The patient was unable to run at the time of initial examination. The patient's goals were to be able to return to running 8-10 miles 6-7 days a week without pain. Based on the patient's history, my initial clinical impression was lateral meniscal tear or ITBFS.

Findings on examination were pelvic and sacral asymmetry, right hip abduction and extension strength of 4/5 (manual muscle testing as described by Kendall[25]), pain with palpation to the left lateral knee, and a negative Ober test. Mild bilateral foot pronation was noted and found to be well corrected and supported with her footwear. The patient's Lower Extremity Functional Scale (LEFS) score was 56/80. The LEFS is a self-reported functional index consisting of 20 items rated on a 5 point scale from 0 (no difficulty) to 4 (extreme difficulty/unable to perform).[26] In a study by Binkley et al[26] the test-retest reliability of the LEFS was found to be excellent (R=.94). My clinical impression after the examination supported my initial impression after taking the patient's history. The examination revealed acute discomfort and a large general pain area consistent with a meniscal tear or ITBFS. After 2 treatments consisting primarily of anti-inflammatory modalities, additional examination procedures were able to be carried out as the patient's pain had decreased by 50%, and she was able to tolerate more aggressive testing procedures. At that time a negative McMurry's test, negative Apley's test, no pain with joint line palpation and a positive Noble compression test supported the diagnosis of ITBFS. See Appendix 1 for a description of testing procedures.

Based on the examination findings, the impairments to be treated were as follows: inflammation of the lateral left knee structures, pelvic and sacral asymmetry, and right hip extensor and abductor weakness. The patient was seen for 13 treatments over a 10 week period to address these impairments. Due to the large pain area at initial examination, ultrasound with 10% hydrocortisone cream was administered for 8 minutes at 1.2 w/cm^2 and the pelvis and sacrum were balanced using muscle energy techniques described by Greenman.[27] At the second visit, the pain area was more localized and iontophoresis using dexamethasone was administered and muscle energy techniques were continued. Iontophoresis was done for 3 visits after which ultrasound was resumed to increase the blood flow to the area in conjunction with starting deep friction massage to the distal ITB. Hip strengthening was introduced after the third visit. The patient was instructed in "clamshell" exercises. The patient was instructed to lie on her left side with her knees bent at approximately 45 degrees. She was instructed to keep the pelvis still and her heels together and lift her top knee off her bottom knee. When she was able to tolerate 2 sets of 15, a medium level resistive band was used to increase the muscle demand.

Outcomes

Hip extensor and abductor strength was found to be within normal limits at the 10th visit. The patient self-limited her running, some days running only a few miles, some days not running at all, depending on pain. At the 12th visit, the patient reported continued moderate pain levels at the 4-5 mile mark. Based on my previous treatment of this patient for a hip dysfunction more than 10 years prior (chart not available) in which a soft orthotic was helpful in the short term, I decided to apply a 3 degree medial rearfoot wedge to each running shoe. My theory was that mild rearfoot pronation with high mileage could increase the tibial motion greater than was being seen in normal gait. This would increase the tension on the ITB to the point of creating ITBFS. The patient was seen 12 days later, and she reported complete resolution of symptoms. At her last appointment she did bring another pair of running shoes that she wanted posted, and notable heel wear and decreased side support of both shoes was observed.

Discussion

The patient described in this case report did not present with any of the anatomical faults theorized to predispose an individual to ITBFS. Although her pelvic asymmetry created a functional leg length difference, this fault was corrected within 2 treatments and was believed to be caused by her antalgic gait rather than being a chronic condition. She presented with hip weakness on her non-involved side, which is an unexpected finding, and she also tested negative for ITB tightness which is thought to be a major contributor to ITBFS. Several articles discuss anti-inflammatory treatments and modified activity with gradual return to activity as an appropriate intervention.[4,7,8,10-12] This was not the case with this patient, even after correction of all identified impairments and a 10 week period of modified activity which included several weeks with no running.

The patient in this case was not initially provided with orthotics for a variety of reasons. She presented with supportive footwear that corrected her mild pronation, and she indicated that she purchased new running shoes at appropriate intervals. Her examination did not include assessing her running gait. Running changes the joint mechanics, increasing hip and knee flexion, and also increases the ground reaction forces up to 250% of body weight, which must be attenuated up the kinetic chain,[28] so observing this activity may have been very informative.

Another factor that could not be simulated in the clinic was running outside. Some authors suggest that running on crowned or banked roads predispose one to knee pain and ITBFS.[4,10] Observing the patient under these circumstances may have indicated there were foot abnormalities or kinematic variables outside the normal ranges that would predispose her to injury.

Shoe wear may have been another factor not effectively evaluated. When she brought in her second pair of running shoes to be posted there was more wear compared to the shoes she usually wore to her clinic visits. A 6-8 month interval may have not been often enough for shoe replacement with such high mileage, or she may have been inaccurate as to how often she actually purchased new shoes.

An implication for clinical practice brought out by this case is how important it is to examine our patients under similar conditions that are known to bring on their symptoms. Broadening the interview portion to determine what surfaces the patient ran on and what side of the road she ran on may have revealed a difference between the position and mechanics of the downside and the upside leg on a banked road. Examining the patient's running gait after the acute inflammation subsided should have been carried out. This may have revealed abnormal foot mechanics that were not apparent in normal gait.

Summary and Conclusion

While patients with ITBFS typically have certain anatomical faults, the clinical examination of this patient did not reveal any of those thought to be associated with this diagnosis. Acute symptoms precluded a gait or running assessment when the patient was initially examined, and even after symptoms decreased, a gait examination done in the clinic did not indicate the need to address her footwear. A running assessment may have provided more information, but would still not take into consideration the terrain of outside running. Further investigation is needed to determine the effects of mild pronation in distance runners and the benefits of orthotic intervention.

References

1. Orchard JW, Fricker PA, Abud AT, Mason BR. Biomechanics of iliotibial band friction syndrome in runners. *J Orthop Sports Phys Ther*. 1990;24(3):375-379.

2. Shamus E, Shamus J. *Sports Injury: Prevention and Rehabilitation*. New York, NY McGraw-Hill; 2001:257-259.

3. Fredericson M, Wolf C. Iliotibial band syndrome in runners: innovations in treatment [abstract]. *Sports Med.* 2005; 35(5):451.

4. Kirk KL, Kuklo T, Klemme W. Iliotibial band friction syndrome. *Orthobluejournal.com.* 2000;23(11):1209-1217.

5. Khaund R, Flynn SH. Iliotibial band syndrome: a common source of knee pain. *Am Fam Physician.* 2005;71(8):1545-1550.

6. Ellis R, Hing W, Reid D. Iliotibial band friction syndrome: a systematic review. *Man Ther.* 2007;12(3):200-208.

7. Renne JW. The iliotibial band friction syndrome. *J Bone Joint Surg Am*. 1975; 57(8):1110-1111.

8. Aronen JG, Chronister R, Regan K,Hensien, MA. Practical conservative management of iliotibial band syndrome. *Phys Sportsmed*. 1993;21(6):59-69.

9. Schwellnus MP, Theunissen L, Noakes TD, Reinach SG. Anti-inflammatory and combined anti-inflammatory/analgesic medication in early management of iliotibial band friction syndrome. *South Afr Med J.* 1991;79(10):602-606.

10. Jones DC, James SL. Overuse injuries of the lower extremity: shin splints, iliotibial band friction syndrome, and exertional compartment syndromes. *Clin Sports Med*. 1987;6(2):273-283.

11. Orava S. Iliotibial band friction syndrome in athletes: an uncommon exertion syndrome on the lateral side of the knee. *Br J Sports Med*. 1978;12(2):69-73.

12. Noble CA. The treatment of iliotibial band friction syndrome. *J Br Sports Med*. 1979; 13(2):51-54.

13. Clemente CD. *Anatomy*. 5th ed. Philadelphia, PA: Lippincott Williams and Wilkins; 2006.

14. Hollinshead WH. *Textbook of Anatomy*. 5rd ed. New York, NY: Harper and Row; 1997.

15. Messier SP, Edwards DG, Martin DF, et al. Etiology of iliotibial band friction syndrome in distance runners. *Med Sci Sports Exerc*. 1995;27(7):951-960.

16. Krivichas LS. Anatomical factors associated with overuse sports injuries. *Sports Med*. 1997;24(2):132-146.

17. Almekinders LC, Temple JD. Etiology, diagnosis, and treatment of tendonitis: an analsysis of the literature. *Med Sci Sports Exerc*. 1998;30(8):1183-1190.

18. Gose JC, Schweizer P. Iliotibial band tightness. *J Orthop Sports Phys Ther.* 1989; 10(10):399-407.

19. Schwellnus MP. Lower limb biomechanics in runners with iliotibial band friction syndrome [abstract]. *Med Sci Sports Exerc*. 1993; 25(5):S68.

20. Cornwall MW, McPoil TG. Footwear and foot orthotic effectiveness research: a new approach. *J Orthop Sports Phys Ther*. 1995;21(6):337-344.

21. Naworzenski DA, Cook TM, Saltzman CL. The effect of foot orthotics on three-dimensional kinematics of the leg and rearfoot during running. *J Orthop Sports Phys Ther*. 1995;21(6):317-327.

22. Reischl SF, Powers CM, Rao S, Perry J. The relationship between foot pronation and rotation of the tibia and femur during walking. *Foot Ankle Int*. 1999;20(8):513-520.

23. Donatelli R, Hurlbert C, Conaway D, St. Pierre R. Biomechanical foot orthotics: a retrospective study. *J Orthop Sports Phys Ther*. 1998;10(6):205-212.

24. Noble CA. Iliotibial band friction syndrome in runners. *Am J Sports Med*. 1980;8(4):232-234.

25. Kendall FP, McCreary EK, Provance PG. Muscles: Testing and Function. 5th ed. Williams and Wilkins, Baltimore, MD; 2005.

26. Binkley JM, Stratford PW, Lott SA, et al. The lower extremity functional scale (LEFS): scale development, measurement properties, and clinical application. *Phys Ther*. 1999;79(4):371-383.

27. Greenman PE. *Principles of Manual Therapy.* 3rd ed. Baltimore, MD: Williams and Wilkins; 2003.

28. Levangie PK, Norkin CC. Joint Structure and Function. 4rd ed. Philadelphia, PA: FA Davis Company; 2005.

29. Konin JG, Wiksten, DL, Isear JA. *Special Tests for Orthopedic Examination*. Thorofare, NJ: Slack; 1997:181-214.

30. Wadsworth CT. *Manual Examination and Treatment of the Spine and Extremities*. Baltimore, MD: Williams and Wilkins; 1988:187.

Appendix 1: Description of tests used in the examination*

	Test Position	Action	Positive Test
Ober test	**Patient lies on non-involved side with hips and knees in extension. Examiner stabilizes the pelvis and supports the lower leg.**	**The involved leg is extended to position the ITB behind the greater trochanter. The examiner then adducts the leg slowly.**	**If the involved leg cannot adduct enough to touch the table this is a positive test, indicating tightness of the ITB.**
McMurray test	**Patient is supine, examiner places one hand with fingers on medial and lateral joint lines of the knee, the other at the patient's heel.**	**The knee is fully flexed then extended by the examiner while holding lower leg in tibial external rotation. The test is repeated with tibia in internal rotation.**	**A click felt by the examiner on the medial side is indicative of a medial meniscal tear. If felt on the lateral side, a lateral tear may be present.**
Apley compression test	**Patient is prone with knee flexed to 90 degrees. The examiner stabilizes thigh with one hand, and the other hand is on patient's heel.**	**A downward force is applied at the heel toward the table while medially and then laterally rotating the tibia.**	**Pain, clicking or restriction of movement is indicative of a meniscal tear.**
Joint line palpation	**Patient is supine in hooklying position.**	**Examiner palpates the medial and lateral joint lines of the knee.**	**Pain from palpation is indicative of a meniscal tear.**
Noble compression test	**Patient is supine with knee flexed to 90 degrees. Examiner places thumb of one hand at lateral femoral epicondyle and other hand at patient's ankle.**	**Examiner passively flexes and extends knee while maintaining pressure over the lateral femoral epicondyle.**	**Pain noted by patient at site of examiners thumb at 30 degrees of flexion indicates ITBFS.**

* Konin JG, Wiksten, DL, Isear JA. *Special Tests for Orthopedic Examination*. Thorofare, NJ: Slack; 1997:181-214.

Wadsworth CT. *Manual Examination and Treatment of the Spine and Extremities*. Baltimore, MD: Williams and Wilkins; 1988:187.